REMARKS

The present Preliminary Amendment is submitted to amend original claims 1-9, 12-14, 17, 20, and 22-31 in order to remove the reference numerals and remove the multiple dependencies in the original claims, thereby placing such claims in condition for examination and reducing the required PTO filing fee.

Also, the abstract has been revised in order to remove the reference numerals therein. Note the changes to the abstract are submitted in the form of a substitute abstract.

Copies of the amended portion of the claims with changes marked therein is attached and entitled *"Version with Markings to Show Changes Made."*

Respectfully submitted,

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Part of #5

CLAIMS

1. (Amended) A component recognizing method for recognizing with one recognition unit ~~(61, 305)~~ surfaces to be recognized of a plurality of components ~~(56, 57, 58, 59, 301, 310)~~ held by a plurality of component holding members ~~(24 to 33, 301)~~ which are vertically moved selectively by a single drive unit ~~(2, 313)~~ and having the surfaces to be recognized of different heights, in which heights of the component holding members are controlled so as to bring the surface to be recognized of each of the plurality of components into a recognizable range ~~(L, H1)~~ of the recognition unit and the surfaces to be recognized of the plurality of components are continuously recognized.

2. (Amended) A component recognizing method as claimed in claim 1, wherein the plurality of components held by the plurality of component holding members ~~(24 to 33, 301)~~ and having the surfaces to be recognized of different heights have such a variation in height that not all the surface to be recognized of the plurality of components are within the recognizable range of the recognition unit when bottom end surfaces of the plurality of component holding members are situated at an identical height.

3. (Amended) A component recognizing method as claimed in claim 2, wherein, among the plurality of components held by the plurality of component holding members ~~(24 to 33)~~ and

having the surfaces to be recognized of different heights which components have such a variation in height that not all the surface to be recognized of the plurality of components are within the recognizable range of the recognition unit when the bottom end surfaces of the plurality of component holding members are situated at an identical height, components of which the surfaces to be recognized are within the recognizable range of the recognition unit are recognized without a selective vertical movement of component holding members holding the components by drive of the single drive unit and without a change in heights of the surfaces, and components of which the surfaces to be recognized are out of the recognizable range of the recognition unit are recognized so that the surfaces to be recognized are recognized after a positioning operation with a vertical movement of component holding members holding the components is controlled so as to bring the surfaces to be recognized into the recognizable range of the recognition unit.

4. (Amended) A component recognizing method as claimed in [any one of] claims 1 [to 3], wherein shapes of the components are recognized when the surfaces to be recognized of the components are recognized.

5. (Amended) A component recognizing apparatus for recognizing with one recognition unit ~~(61, 305)~~ surfaces to be

recognized of a plurality of components ~~(56, 57, 58, 59, 301, 310)~~ held by a plurality of component holding members ~~(24 to 33, 301)~~ which are vertically moved selectively by a single drive unit ~~(2, 313)~~ and having the surfaces to be recognized of different heights, heights of the component holding members are adapted to be controlled so as to bring the surface to be recognized of each of the plurality of components into a recognizable range ~~(I, H1)~~ of the recognition unit and continuously recognizes the surfaces to be recognized of the plurality of components.

6.(Amended) A component recognizing apparatus as claimed in claim 5, wherein the plurality of components held by the plurality of component holding members ~~(24 to 33, 301)~~ and having the surfaces to be recognized of different heights have such a variation in height that not all the surface to be recognized of the plurality of components are within the recognizable range of the recognition unit when bottom end surfaces of the plurality of component holding members are situated at an identical height.

7.(Amended) A component recognizing apparatus as claimed in claim 6, wherein, among the plurality of components held by the plurality of component holding members ~~(24 to 33)~~ and having the surfaces to be recognized of different heights which components have such a variation in height that not all the surface to be recognized of the plurality of

components are within the recognizable range of the recognition unit when the bottom end surfaces of the plurality of component holding members are situated at an identical height, components of which the surfaces to be recognized are within the recognizable range of the recognition unit are recognized without a selective vertical movement of component holding members holding the components by drive of the single drive unit and without a change in heights of the surfaces, and components of which the surfaces to be recognized are out of the recognizable range of the recognition unit are recognized so that the surfaces to be recognized are recognized after a positioning operation with a vertical movement of component holding members holding the components is controlled so as to bring the surfaces to be recognized into the recognizable range of the recognition unit.

8. (Amended) A component recognizing apparatus as claimed in [any one of] claims 5 [to 7], wherein shapes of the components are adapted to be recognized when the surfaces to be recognized of the components are recognized.

9. (Amended) A component mounting apparatus comprising:

a single drive unit ~~(2, 313)~~;

a plurality of component holding members ~~(24 to 33, 301)~~ which are adapted to be vertically moved selectively by the single drive unit and hold a plurality

of components ~~(56, 57, 58, 59, 301, 310)~~;

a head unit ~~(60, 303)~~ including the single drive unit and the plurality of component holding members; and

one recognition unit ~~(61, 305)~~ which is adapted to recognize surfaces to be recognized of the plurality of components held by the plurality of component holding members when the surfaces to be recognized are within a recognizable range ~~(L, H1)~~,

wherein heights of the component holding members is adapted to be controlled so as to bring the surface to be recognized of each of the plurality of components into the recognizable range of the recognition unit and continuously recognizes the surfaces to be recognized of the plurality of components, when the surfaces to be recognized of the plurality of components held by the plurality of component holding members and having the surfaces to be recognized of different heights are recognized with the one recognition unit while the head unit is moving.

10. A component mounting apparatus as claimed in claim 9, wherein the plurality of components held by the plurality of component holding members and having the surfaces to be recognized of different heights have such a variation in height that not all the surface to be recognized of the plurality of components are within the

recognizable range of the recognition unit when bottom end surfaces of the plurality of component holding members are situated at an identical height.

11. A component mounting apparatus as claimed in claim 9, wherein, among the plurality of components held by the plurality of component holding members and having the surfaces to be recognized of different heights which components have such a variation in height that not all the surface to be recognized of the plurality of components are within the recognizable range of the recognition unit when the bottom end surfaces of the plurality of component holding members are situated at an identical height, components of which the surfaces to be recognized are within the recognizable range of the recognition unit are recognized without a vertical movement of component holding members holding the components and without a change in heights of the surfaces, and components of which the surfaces to be recognized are out of the recognizable range of the recognition unit are recognized so that the surfaces to be recognized are recognized with the recognition unit after a positioning operation with a selective vertical movement of component holding members holding the components by drive of the single drive unit is controlled so as to bring the surfaces to be recognized into the recognizable range of the recognition unit.

12. (Amended) A component mounting apparatus as claimed in any one of claims 9 to 11, wherein shapes of the components are adapted to be recognized when the surfaces to be recognized of the components are recognized.

13. (Amended) A component mounting apparatus as claimed in any one of claims 9 to 12, further comprising: a table ~~(3, 318)~~ which is adapted to be vertically moved by the single drive unit; and cylinders ~~(4 to 13, 320)~~ which are fixed to the table, corresponding to the component holding members, and is adapted to bring a tip of a piston into contact with only the component holding member selected so as to be vertically moved among the plurality of component holding members and thereby transmit vertical movement of the table to the selected component holding member.

14. (Amended) A component recognizing method as claimed in any one of claims 1 to 4, further comprising:

producing a velocity curve in vertical movement of the selected component holding member with parameters of a target position in a direction of height at time when the vertical movement of the selected component holding member is controlled by means of the drive unit so as to position the surface to be recognized of a component within the recognizable range of the recognition unit, a maximum velocity in the vertical movement of the selected component holding member up to the target position, and a maximum

acceleration in the vertical movement of the selected component holding member up to the target position, and

automatically starting a positioning operation, into the recognizable range, of the surface to be recognized of the component held by the selected component holding member driven by the drive unit on a basis of the velocity curve in response to a positioning operation starting instruction upon arrival at a positioning operation starting position of the selected component holding member moving transversely toward the recognition unit.

15. A component recognizing method as claimed in claim 14, wherein a plurality of sets of parameters of the target positions and the positioning operation starting positions are provided and continuous positioning operations are thereby executed with provision of a plurality of timings.

16. A component recognizing method as claimed in claim 15, further comprising, with a plurality of positioning operation ending positions corresponding to the plurality of positioning operation starting positions provided, judging whether individual positioning operations in continuous positioning operations which were started at the plurality of positioning operation starting positions have reached the respective positioning operation ending positions or not so as to detect whether the respective

positioning operations have been done normally or not.

17 (Amended) A component recognizing apparatus as claimed in [any one of] claims 5 [to 8], comprising:

a first control unit ~~(102)~~ which is adapted to produce a velocity curve in vertical movement of the selected component holding member with parameters of a target position in a direction of height at time when the vertical movement of the selected component holding member is controlled by means of the drive unit so as to position the surface to be recognized of a component within the recognizable range of the recognition unit, a maximum velocity in the vertical movement of the selected component holding member up to the target position, and a maximum acceleration in the vertical movement of the selected component holding member up to the target position; and

a second control unit ~~(103, 106)~~ which is adapted to drive the drive unit in response to a positioning operation starting instruction and automatically start a positioning operation of the selected component holding member driven by the drive unit on a basis of the velocity curve, upon arrival at a positioning operation starting position of the selected component holding member moving transversely toward the recognition unit.

18. A component recognizing apparatus as claimed in claim 17, wherein a plurality of sets of parameters of the

target positions and the positioning operation starting positions are provided and thereby the second control unit is adapted to execute continuous positioning operations with provision of a plurality of timings.

19. A component recognizing apparatus as claimed in claim 18, wherein with a plurality of positioning operation ending positions corresponding to the plurality of positioning operation starting positions provided, the second control unit is adapted to judge whether individual positioning operations in continuous positioning operations which were started at the plurality of positioning operation starting positions have reached the respective positioning operation ending positions or not and thereby detects whether the respective positioning operations have been done normally or not.

20. (Amended) A component mounting apparatus as claimed in claim 9, wherein the single drive unit is a single motor, and the single motor is adapted to drive a ball screw to rotate and thereby vertically moves a table ~~(3)~~ that is in screw engagement with the ball screw,

the apparatus further comprising: cylinders ~~(4 to 13)~~ which are fixed to the table, corresponding to the component holding members, and is adapted to bring a tip of a piston into contact with only the component holding member selected so as to be vertically moved among the

plurality of component holding members and thereby transmit vertical movement of the table to the selected component holding members;

a first control unit ~~(102)~~ which is adapted to produce a velocity curve in vertical movement of the selected component holding members by means of the single motor, with parameters of a target position in a direction of height at time when the vertical movement of the selected component holding members is controlled by means of the single motor so as to position the surface to be recognized of a component within the recognizable range of the recognition unit, a maximum velocity in the vertical movement of the selected component holding members up to the target position, and a maximum acceleration in the vertical movement of the selected component holding members up to the target position; and

a second control unit ~~(103, 106)~~ which is adapted to drive the single motor in response to a positioning operation starting instruction and automatically start positioning operations of the selected component holding members driven by the single motor on a basis of the velocity curve, upon arrival at a positioning operation starting position of the selected component holding members moving with the head unit transversely toward the recognition unit.

21. A component mounting apparatus as claimed in claim 20, further comprising a transverse movement motor for moving the component holding members in transverse direction, wherein

the first control unit is further adapted to produce a velocity curve in transverse movement of the selected component holding members by means of the transverse movement motor, with parameters of a target position in transverse direction at time when the transverse movement of the selected component holding members up to vertical drive starting positions for the selected component holding members is controlled by means of the transverse movement motor, for recognition of the surface to be recognized of a component within the recognizable range of the recognition unit, a maximum velocity in the transverse movement of the selected component holding members up to the target position, and a maximum acceleration in the transverse movement of the selected component holding members up to the target position, and

the second control unit is adapted to drive the transverse movement motor in response to the positioning operation starting instruction and automatically start positioning operations of the selected component holding members driven by the transverse movement motor on the

basis of the velocity curve, upon arrival at the positioning operation starting position of the selected component holding members moving with the head unit transversely toward the recognition unit.

22. (Amended) A component mounting method in which the plurality of components from component feeding units are held by the plurality of component holding members, the components are thereafter recognized with the component recognizing method as claimed in [any one of] claims 1 [to 4 and claims 14 to 16], postures of the plurality of components held by the plurality of component holding members are thereafter corrected on a basis of a recognition result, and the components are thereafter installed on an object to be installed.

23. (Amended) A component mounting apparatus which is adapted to hold the plurality of components from component feeding units by the plurality of component holding members, thereafter recognize the components with the recognition unit of the component recognizing apparatus as claimed in [any one of] claims 5 [to 8 and claims 17 to 19], thereafter correct postures of the plurality of components held by the plurality of component holding members on a basis of a recognition result, and thereafter install the components on an object to be installed.

24. (Amended) A component recognizing method as claimed in

claim 1, wherein

after the plurality of component holding members holding the plurality of components having the surfaces to be recognized of different heights are moved in one direction over the one recognition unit, the plurality of component holding members are moved in a reverse direction opposite to the one direction over the one recognition unit with heights of the plurality of component holding members changed, and

all the plurality of components held by the plurality of component holding members are imaged with the recognition unit in respective movement of the plurality of component holding members in the one direction and in the reverse direction, and the surfaces to be recognized of only components having the surfaces to be recognized brought into the recognizable range ~~(L)~~ of the recognition unit among the plurality of components are recognized.

25.(Amended) A component recognizing method as claimed in claim 1, wherein

the plurality of component holding members holding the plurality of components having the surfaces to be recognized of different heights are moved in one direction over the one recognition unit and the surfaces to be recognized of only components having the surfaces to be recognized brought into the recognizable range ~~(L)~~ of the

recognition unit among the plurality of components held by the plurality of component holding members are recognized, and

heights of the plurality of component holding members are changed and the plurality of component holding members are thereafter moved in a reverse direction opposite to the one direction over the one recognition unit and the surfaces to be recognized of only components having the surfaces to be recognized brought into the recognizable range ~~(L)~~ of the recognition unit among the plurality of components held by the plurality of component holding members are recognized.

26. (Amended) A component recognizing method as claimed in claim 1, wherein

the plurality of component holding members holding the plurality of components having the surfaces to be recognized of different heights are moved over the one recognition unit and the surfaces to be recognized of only components having the surfaces to be recognized brought into the recognizable range ~~(L)~~ of the recognition unit among the plurality of components held by the plurality of component holding members are recognized, and

heights of the plurality of component holding members are changed and the plurality of component holding members are thereafter moved over a recognition unit other

than the one recognition unit and the surfaces to be recognized of only components having the surfaces to be recognized brought into the recognizable range ~~(L)~~ of the recognition unit among the plurality of components held by the plurality of component holding members are recognized.

27. (Amended) A component recognizing apparatus as claimed in claim 5, further comprising a control unit ~~(307)~~ which is adapted to move the plurality of component holding members holding the plurality of components having the surfaces to be recognized of different heights in one direction over the one recognition unit, thereafter move the plurality of component holding members in a reverse direction opposite to the one direction over the one recognition unit with heights of the plurality of component holding members changed, perform imaging with the recognition unit of all the plurality of components held by the plurality of component holding members in respective movement of the plurality of component holding members in the one direction and in the reverse direction, and recognize the surfaces to be recognized of only components having the surfaces to be recognized brought into the recognizable range ~~(L)~~ of the recognition unit among the plurality of components.

28. (Amended) A component recognizing apparatus as claimed in claim 5, further comprising a control unit ~~(307)~~ which is adapted to move the plurality of component holding members

holding the plurality of components having the surfaces to be recognized of different heights in one direction over the one recognition unit, recognize the surfaces to be recognized of only components having the surfaces to be recognized brought into the recognizable range ~~(H)~~ of the recognition unit among the plurality of components held by the plurality of component holding members, move the plurality of component holding members in a reverse direction opposite to the one direction over the one recognition unit after changing heights of the plurality of component holding members, and recognize the surfaces to be recognized of only components having the surfaces to be recognized brought into the recognizable range ~~(H)~~ of the recognition unit among the plurality of components held by the plurality of component holding members.

29. (Amended) A component recognizing apparatus as claimed in claim 5, further comprising: another recognition unit ~~(311)~~ capable of recognizing surfaces to be recognized of components having heights of the surfaces to be recognized different from those of components which are recognized by means of the one recognition unit ~~(305)~~; and

a control unit ~~(307)~~ which is adapted to move the plurality of component holding members holding the plurality of components having the surfaces to be recognized of different heights over the one recognition

unit, recognize the surfaces to be recognized of only components having the surfaces to be recognized brought into the recognizable range ~~(L)~~ of the recognition unit among the plurality of components held by the plurality of component holding members, move the plurality of component holding members over the another recognition unit other than the one recognition unit after changing heights of the plurality of component holding members, and recognize the surfaces to be recognized of only components having the surfaces to be recognized brought into the recognizable range ~~(L)~~ of the another recognition unit among the plurality of components held by the plurality of component holding members.

30. (Amended) A component recognizing method comprising:

moving a plurality of component holding members holding a plurality of components having surfaces to be recognized of different heights in one direction over a recognition unit, thereafter moving the plurality of component holding members in a reverse direction opposite to the one direction over the recognition unit with heights of the plurality of component holding members changed; and

recognizing the surfaces to be recognized of components having the surfaces to be recognized brought into the recognizable range ~~(L)~~ of the recognition unit among the plurality of components held by the plurality of component holding members in respective movement of the plurality of

component holding members in the one direction and in the reverse direction.

31. (Amended) A component recognizing apparatus comprising:

a plurality of component holding members which is adapted to hold a plurality of components having surfaces to be recognized of different heights;

a recognition unit over which the plurality of component holding members are capable of moving in one direction and in a reverse direction opposite to the one direction and, after moved in the one direction, are moved in the reverse direction opposite to the one direction with heights of the plurality of component holding members changed and which is adapted to perform imaging of all the plurality of components held by the plurality of component holding members in respective movement of the plurality of component holding members in the one direction and in the reverse direction; and

a control unit ~~(307)~~ which is adapted to recognize the surfaces to be recognized of only components having the surfaces to be recognized brought into a recognizable range ~~(L)~~ of the recognition unit among the plurality of components.

ABSTRACT

There are provided component recognizing method and apparatus and component mounting method and apparatus by which components with various heights held by a plurality of nozzles can be recognized continuously. The drive of a head ~~(60)~~ is transmitted to nozzles ~~(24 to 33)~~, surfaces to be recognized of components ~~(56 to 59)~~ are controlled so as to be positioned in a recognizable range ~~(L)~~ in respective recognizing operations of the components, and the continuous recognition is thereby made possible. The adjustment of the heights of the surfaces to be recognized in the recognizing operations of the components is achieved by one drive unit ~~(2)~~ and a plurality of drive transmitting units ~~(4 to 13)~~.